Metrec·X
User Manual

Version 1.61
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General Description of the Instrument

AML Oceanographic X•Series instruments and Xchange™ sensors are a major advancement in ocean instrumentation. Swappable and interchangeable sensors dramatically improve the capabilities of ocean instrumentation in the following ways:

- Change the instrument sensor types while at sea within seconds, and without tools. A CTD can be changed to a sound speed profiler by exchanging sensor heads.
- To optimize the resolution and accuracy of sensor data, sensors can be swapped to change the measurement range. For example, a 6000 dBar P•Xchange pressure sensor can be swapped with a 500 dBar P•Xchange sensor; the salt water C•Xchange conductivity sensor can be swapped for a fresh water C•Xchange conductivity sensor.
- Sensors from one instrument can be swapped to another instrument to maintain mission-critical capabilities.
- Calibrated sensors can be sent from the factory to the instrument. The instrument is not pulled from active duty for calibration.
- Spare sensors ensure that an instrument can be immediately returned to active duty after sustaining damage.
- All calibration and traceability data resides within each Xchange™ sensor. Calibration data for all sensors is available from the instrument, and calibration certificates can be printed from AML Oceanographic SeaCast software when the instrument is connected.
- Logged data is stamped with sensor traceability and instrument configuration data.
- Only Xchange™ sensors are sent for calibration, leaving the instrument working in the field.

Metrec•X is an externally-powered, multi-parameter instrument that allows you to change the instrument's sensor load, in the field and on-demand. The instrument can output data in real-time and log data to its internal memory simultaneously.

Metrec•X may be equipped with multiple primary Xchange™ sensor ports (C•Xchange or SV•Xchange) and multiple secondary Xchange™ sensor ports (T•Xchange, P•Xchange, Turbidity•Xchange, UV•Xchange).

Sampling rates are set by time (2 Hz to every 24 hours), by pressure (0.1 dbar or greater increments), or by sound speed (0.1 m/s or greater increments).

Supported communication protocols for Metrec•X are RS-232 or RS-485. The instrument must be connected to a power supply capable of supplying +8 to 26 VDC with minimal line noise.

Any Metrec•X with a P1S4 configuration is compatible with UV•Xchange. Additionally, there is an "independent UV" option featuring a secondary port dedicated specifically to UV•Xchange. This separately powered port includes a Duty Cycle Controller to minimize power use while maximizing the effectiveness of the biofouling control system. It is wired internally into a Micro-6 connector and is powered through two dedicated lines on the communication cable.

Where Do I Start?

AML Oceanographic X•Series instruments ship with several manuals on the USB stick:

- An instrument manual (this Metrec•X manual) providing an overview on how to use and maintain the instrument;
- A SeaCast manual providing instructions on how to use the software to configure the instrument and review instrument data;
- Xchange™ sensor manuals (C•Xchange™, SV•Xchange™, P•Xchange™, T•Xchange™, Turbidity•Xchange™ and UV•Xchange™) providing overviews on how to install and maintain each of the Xchange™ sensors;

If you are configuring an instrument for field use or lab testing, begin with the SeaCast manual.

If you are performing instrument maintenance, begin with the instrument manual.

If you are planning to swap an Xchange™ sensor, read the Xchange™ manual corresponding to your sensors.

If Metrec•X is equipped with UV•Xchange, refer to the UV•Xchange manual.

Shipping & Receiving

Receiving an Instrument

When receiving an instrument, perform the following steps to ensure the instrument will be ready for deployment when required:

- Inspect the shipping container, looking for signs of damage. Damage to the shipping container could indicate damage to the instrument inside.
- The shipping package should include all of the following items
    - Metrec•X instrument
    - Data/Power cable
    - Black dummy plug
    - Two primary sensor blanking plug
    - Two secondary sensor blanking plugs
    - USB stick with manuals and documentation
- Check for damage
    - Check the cable for slices or gouges
    - Check the connector sockets for corrosion, dirt, and salt deposits
    - Check the pressure case for dents and scrapes
    - Check the sensors for cracks or bends
- Ensure all the Xchange™ sensors are installed tightly onto their mounts. The blue locking sleeve should be tight, and sitting less than 1mm from the instrument end cap.
- Connect the instrument to a computer with the data cable and perform a scan or monitor if using SeaCast.

Returning an Instrument to the Factory

- If shipping for repair or recalibration, obtain an RMA number from the service centre.
- Pack the instrument in its original shipping box to prevent damage during shipping.

An RMA number can be requested using the contact options given in the Support section of this manual

Using the Instrument

Pressure Ratings

Pressure ratings are given for Xchange™ sensors and the entire instrument. **Deployments should never exceed the lower of these two pressure ratings.** For example, a 500m instrument equipped with a 6000 dBar (0-6000m) P•Xchange™ sensor is limited to deployments of 500m depth or less. Similarly, a 6000m instrument equipped with a 500 dBar (0-500m) P•Xchange™ sensor is also limited to deployments of 500m depth or less.

It is desirable to optimize the accuracy of pressure measurements by using a P•Xchange™ sensor with a pressure range that closely matches the depth of the deployment.

Caution: Do not exceed the specified pressure ratings of the P•Xchange™ sensor, Turbidity•Xchange™ sensor, or the instrument housing. Turbidity•Xchange™ sensors are limited to deployments of 500m of less, regardless of the pressure rating of the instrument on which they are installed. Overpressure can result in damage to the sensors and the instrument.

Pre-Deployment Procedures

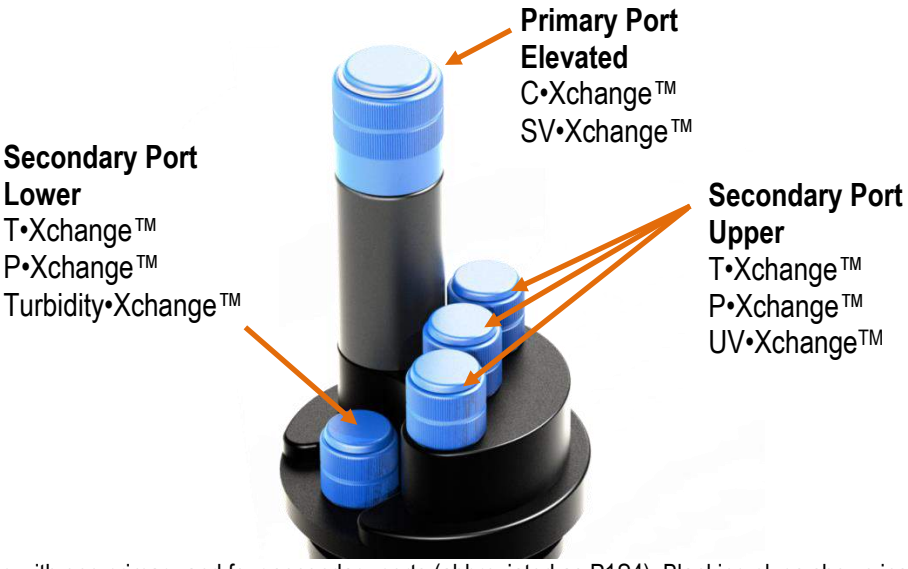
- Upon Receipt
  - Use the Shipping and Receiving instructions to verify the condition of the instrument.
  - Verify that all sensor calibrations are valid for the duration of the deployment. If not, swap the Xchange™ sensors for sensors with valid calibrations or send the Xchange™ sensors to a service centre for recalibration.
  - Lightly lubricate the underwater connectors with 3M silicone spray or equivalent.
- Before leaving the jetty
  - If applicable, verify the P•Xchange™ pressure range is correct for the deployment.
  - Connect the instrument to a computer using the data cable.
  - Check the instrument memory
    - Save any unsaved memory files.
    - Initialize the memory (Note: This deletes ALL files stored in the instrument memory. Be sure to have a copy of all important logged data before performing this step.).
      - If using SeaCast, click the *Clear Memory* box.
      - If using a Terminal Emulator, send instrument an *INIT* command.

Caution: Install blanking plugs in all unused sensor ports prior to deployment. Failure to install blanking plugs will result in damage to the connectors.

C•Xchange™ & SV•Xchange™ blanking plug

T•Xchange™, P•Xchange™ & Turbidity•Xchange™ blanking plug

Supported Sensor Configurations



Metrec•X endcap with one primary and four secondary ports (abbreviated as P1S4). Blanking plugs shown installed. Metrec•X endcaps are available with different combinations of ports to allow for a wide variety of sensor combinations.

Swappable sensors allow you to configure your instrument in a number of different ways. See tables below for two endcap styles and popular sensor combinations. Note that not all supported sensor combinations are shown. It is possible, for example, to install two T•Xchange™ sensors, or two P•Xchange™ sensors simultaneously for cross verification, or in the case of Turbidity•Xchange™, using two different ranges to capture both high and low events accurately.

P2S2 Endcap				
Port Type	Primary (P2)		Secondary (S2)	
Port Level	Elevated ↑↑	Upper ↑	Upper ↑	Lower ↓
1	C	SV	T	P
2	C	SV	P	T
3	C	SV	T	Turbidity
4	C	SV	P	Turbidity

P1S4 Endcap					
Port Type	Primary (P1)	Secondary (S4)			
Port Level	Elevated ↑↑	Upper ↑	Upper ↑	Upper ↑	Lower ↓
1	C	T	P	UV•Xchange	Turbidity
2	C	P	T	UV•Xchange	Turbidity
3	SV	T	P	UV•Xchange	Turbidity
4	SV	P	T	UV•Xchange	Turbidity

Note that UV•Xchange is only compatible with P1S4 style endcaps and may require configuration particular to the sensor payload installed. Refer to UV•Xchange manual for configuration details.

LED Indicator

The LED indicator is located next to the data/power connector on the instrument top end cap.

- The LED indicator will be on whenever the data/power cable is plugged into the instrument.
- The instrument will not start logging until it is immersed in water and it takes its first sample at the programmed sampling rate.

The LED indicator displays are as follows:

- **LED is a constant green**: This indicates the instrument is on and the external power is greater than 9.9V
- **LED is flashing green**: The instrument is logging data and the external power is greater than 9.9V
- **LED is a constant red**. This indicates the instrument is on and the external power is less than 9.9V. Try to supply power at higher voltage for best reliability.
- **LED is flashing red**. The instrument is logging data and the external power is less than 9.9V
- **LED is off with data/power cable attached**. The instrument is not working properly. Consult the troubleshooting section or call the service department.

Configuring Sampling Parameters Using SeaCast

Please refer to the SeaCast Manual.

Configuring Sampling Parameters with HyperTerminal

Instruments can also be configured for deployment using HyperTerminal or other terminal emulation programs. As with SeaCast, communications with the instrument must be established using the correct communications port and settings. The communications settings are 8 data bits, 1 stop bit, no parity, no flow control, and the desired baud rate. The following steps must be completed by issuing text commands:

Step	Possible Commands
Initialize Memory (erases instrument memory)	INIT
Set Log File Name	SET LOG filename.txt
Set Instrument Time & Date	SET TIME hh:mm:ss SET DATE mm/dd/yy
Set Sampling Parameters	SET SAMPLE RATE CONTINUOUS SET SAMPLE RATE 5/s SET P INC 1 SET SOUND INC 2

The above table provides example commands only; many additional sampling regimes can be established using available commands. Please consult the Commands section of the Appendix for full syntax details on the commands you wish to use.

Accounting for Atmospheric Pressure Variations at the Surface

Climate and altitude changes can create fluctuations in atmospheric (barometric) pressure. AML's pressure sensors are sensitive enough to detect these variations. When this happens, the instrument's pressure channel may not read exactly zero when data is taken prior to submersion in the water. Nearly all absolute pressure sensors experience atmospheric pressure offsets if they are sufficiently sensitive.

To compensate for this atmospheric pressure offset, AML instruments have the ability to reset the pressure sensor's zero point. This can be initiated using AML Oceanographic SeaCast software or a Terminal emulator command. The compensation does not affect the calibration of the pressure sensor, and can be turned off or recalculated at any time. The compensation factor is applied through the entire calibrated pressure range. Note that this compensation cannot be applied to a built-in Paroscientific Digiquartz sensor, as found in bathyMetrec•X.

Once the atmospheric pressure compensation is applied, it will be applied to all pressure sensor data until it is turned off or recalculated. The setting is written to memory, so it remains set when the instrument is powered down.

Using SeaCast

Refer to the SeaCast User Manual for instructions on enabling "Zero Depth."

Using a Terminal Emulator

- Establish serial communications with the instrument on your computer. Refer to the "Communications" section of this manual for more information.
- Once connection is established, ensure the instrument is stationary, and is not submerged in water.
- To turn ON Atmospheric pressure compensation, issue the *ZERO ON* command. This will calculate and apply the offset required to compensate for current atmospheric pressure conditions.
- To turn OFF Atmospheric pressure compensation, issue the *ZERO OFF* command. This will disable the offset.
- Issuing the *ZERO* command again will calculate a new offset based on current conditions.

Logging a Profile

- Ensure the pre-deployment procedures have been completed (see page 5).
- **Metrec•X is a real-time instrument with the ability to log data. To enable logging, send the command *SET SCAN LOGGING* to the instrument (see Commands section).**
- Plug the data/power cable into the instrument.
- Ensure that the desired sampling settings have been selected and applied.
- With the instrument in air (NOT submerged), use the *ZERO* command to zero the barometric pressure offset (P•Xchange™ only).
- Enter the *M* or *MONITOR* command to begin monitoring data. All monitored data will be logged, provided the *SET SCAN LOGGING* command is enabled.
- The status LED should start to flash green to indicate data is being logged. Keep the instrument at this depth for 2 minutes prior to beginning the cast. This allows time for the sensors to fully wet and for the pressure case to shed heat.

- Send the instrument down to the desired depth and return it to the surface.

Monitoring Real Time Data

- Ensure the pre-deployment procedures have been completed (see page 5).
- Ensure that the desired sampling settings have been selected and applied.
- Plug the data/power cable into the instrument. If you power the instrument externally over a long cable, please note the following:
    - Voltage drop due to cable resistance increases with cable length. The voltage drop on a standard AML cable, with a standard bathyMetrec•X, is about 2 volts per 100m of cable while sampling and 0 volts per 100m when in low power mode.
    - The instrument's low voltage warning triggers at 9.9 volts or less.
    - The instrument's auto shutdown triggers when supplied with 8.0 volts or less.
    - The instrument's maximum voltage is 36 volts.
    - The voltage at the instrument, while sampling, must be above the shutdown level for the instrument to operate.
- With the instrument in air, use the *ZERO* command to zero the barometric pressure offset (P•Xchange™ only).
- Lower the instrument until the sensors are fully submerged; the LED should start to flash green. Keep the instrument at this depth for 2 minutes prior to beginning the cast. This allows the sensors time to wet, and the pressure case to shed heat.
- Begin monitoring data using SeaCast or HyperTerminal.
- Send the instrument down to the desired depth and return it to the surface.

Post-Deployment Procedures

- When the instrument is pulled from the water it should be rinsed with fresh water.
- Dry the area around the connectors with a clean cloth or compressed air prior to disconnecting the plugs or cables. Do not blow compressed air into the Pressure•Xchange™ sensor. Doing so may damage the sensitive pressure transducer diaphragm.
- Remove the cable. Place the dummy plug in the connector to protect it.
- Dry the instrument and stow it securely.

Viewing your Data

You may download and view data using SeaCast or HyperTerminal. Please refer to the SeaCast manual to which outlines the steps to download and review your data.

Metrec•X with Independent UV

The independent UV option is offered for situations where economic power usage is critical but biofouling protection is still desired. By running the UV independently through a DCC, the instrument can take advantage of all its power saving features, shutting down between measurements while UV•Xchange continues to prevent fouling uninterrupted on a different power source.

If the independent UV option is selected, the Metrec•X will be configured as a P1S3+UV, which is a P1S4 where one of the secondary ports is dedicated to UV•Xchange. This port is marked with "UV ONLY."

Configuration of the Duty Cycle Controller

The default setting for the DCC is a repeating pattern of 20 minutes on and 20 minutes off. This can be configured at user request for any combination of 2-minute increments in a repeating 120-minute period. The on-off timer begins immediately once the controller is supplied with power.

> Note: If powered through the dedicated port, configuration options for the UV•Xchange will not be accessible through SeaCast.

Power

Power to the UV port is independent from the rest of the instrument. If the independent UV option is selected, two pins on the connector that are normally unused are activated for this purpose.

Pin 5	UV VDC
Pin 6	UV GND

Power must be supplied continuously. When the DCC is in an "on" cycle, power is passed through to the device connected to the output. No power is passed to the output during an "off" cycle. The timing board itself consumes less than 0.1mA during both "on" and "off" cycles.

Maintaining the Instrument

Periodic Maintenance

Periodic preventative maintenance will prolong the life of the instrument. The following steps are recommended:

- If the instrument is very dirty or oily, allow it to soak in warm, soapy water before cleaning with a rag or soft brush. When finished, rinse with fresh water to remove any residual soap or dirt.
- Before each use:
    - Check for proper installation of all Xchange™ sensors.
    - Check for nicks and cuts on the cable.
- After each use:
    - Clean and rinse the instrument using fresh water.
    - Dry the instrument completely, and store it in a cool, dry place.
- Monthly:
    - Lightly lubricate the connector contacts with 3M silicone spray or equivalent. Avoid the use of grease. It can create internal pressure and push past the connector seals on the pins.
    - Lubricate the end cap retainer rings with silicone grease.
- Yearly:
    - Send the instrument or Xchange™ sensors to a service centre for diagnostics and re-calibration.

Communications

PC Settings

Metrec•X will communicate with both RS-232 and RS-485 serial connections. The computer to which the instrument is connected must be set up as follows:

- 8 bits
- 1 stop bit
- No parity
- No hardware flow control
- Baud rate of 600, 1200, 2400, 4800, 9600, 19200, or 38400 baud

After power up, the Metrec•X will wait for an ASCII carriage return. The instrument will automatically detect whether communications are RS-232 or RS-485 as well as the baud rate.

Output Formats

Output formats can be modified. If the required modifications are not supported by the commonly used command list in the next section, please contact the factory for support with custom output formats.

Formatting can be changed in the following ways:

- The number of decimal places for each channel
- Turn on or off
    - o date and time
    - o calculated parameters (salinity, density and calculated SV)
    - o power up information (header)
    - o automatic monitoring on power up

Default Output Format

The output from Metrec•X is space delimited values.

The following table shows the output units for each Xchange™ sensor:

Sensor	Units	Default Format
SV•Xchange™	m/s	1234.567
Conductivity•Xchange™	mS/cm	12.346
Pressure•Xchange™	dBar	1234.56
Temperature•Xchange™	C	12.345
Turbidity•Xchange™	NTU	1234.56
UV•Xchange™	-	1 (1 indicates UV on, 0 indicates UV off)

The default data channel outputs with all calculated parameters turned on are the following:

P1S4 Configuration (with SV, P, T, and Turbidity sensors)

Date	Time	Sound velocity	Pressure	Temperature	Dissolved Oxygen	Turbidity	Battery	Density	Salinity
mm/dd/yy	hh:mm:ss.ss	m/s	dBar	C	mg/L	NTU	volts	kg/m^3	ppt

P2S2 Configuration (with SV, C, P, T sensors)

Date	Time	Sound Velocity	Conductivity	Pressure	Temperature	Battery	Density	Salinity	Calc SV
mm/dd/yy	hh:mm:ss.ss	m/s	mS/cm	dbar	C	volts	kg/m^3	ppt	m/s

Note: These are examples of the default configurations. Your data channel outputs will be entirely dependent on which Xchange™ sensors are installed.

Default Example Outputs

Keyboard inputs in the output capture shown below are in bold type.

METREC.X Version 4.13.10 SN:50002
AML Oceanographic Ltd.
969.0 MBytes installed

>**scan**
05/08/12 12:56:06.54 1486.164 00.076 -0000.13 21.244 009.85

>**monitor**
05/08/12 12:56:08.26 1486.164 00.076 0000.02 21.244 009.83
05/08/12 12:56:08.32 1486.165 00.077 -0000.06 21.244 009.85
05/08/12 12:56:08.37 1486.169 00.077 -0000.06 21.244 009.85
05/08/12 12:56:08.44 1486.169 00.076 0000.09 21.244 009.85
05/08/12 12:56:08.51 1486.163 00.075 0000.17 21.244 009.85
05/08/12 12:56:08.58 1486.165 00.076 0000.17 21.244 009.85
05/08/12 12:56:08.65 1486.166 00.077 0000.25 21.244 009.85
05/08/12 12:56:08.72 1486.167 00.078 0000.09 21.244 009.85

>**dis options**
[Instrument]
Type=METREC.X
EmulationMode=disabled
UseCustomHeader=yes
SN=50002
Firmware=V4.13.10
SampleUnits=continuous
SampleInterval=0
PressureInc=0.00
SoundInc=0.00
LogFile=data.txt
Date=05/08/12
Time=12:56:28
MemorySize=969.0 MB
MemoryUsed=7.6 MB
DisplayTime=yes
DisplayDate=yes

DisplaySalinity=no
DisplayDensity=no
DisplaySoundVelocity=no
DisplayBattery=yes
RelayMode=RS232 mode
RealtimeLogging=no
LoggingTimeout=0
StartupDelay=10
DisplayHeader=yes
StartupMode=prompt
CharacterReception=yes
LoggingBreakMode=no
DetectionMode=A3
BatteryACoefficient=+3.500000E-01
BatteryBCoefficient=+2.500000E-02
ShutDownVoltage=8.0
WarningVoltage=9.9
PressureOffset=0.00
UsePressureOffset=no
SoundVelocityThreshold=1375.00
DelimterMode=Space
SensorDetectionMode=Once
Traceability=yes
SkipPowerOff=no
AnalogChannels=2

[Slot 1]
SensorName=SV-C.Xchange SV.X SN 201579 04/26/12
BoardSN=04258

[Slot 3]
SensorName=SV-C.Xchange C.X SN 500237 05/04/12
BoardSN=04248

[Slot 5]
SensorName=P-T.Xchange P.X SN 300312 05/04/12 T.X SN 400458 05/04/12
BoardSN=03905

>**dir**

test .raw 1750 05/08/12 12:52:16.00
data .txt 1750 05/08/12 12:54:18.00

961 MBytes free
7 MBytes Used
2 File(s) listed

>**dump data.txt**

[cast header]
InstrumentSN=50002
Date=05/08/12
Time=12:54:18.87
PressureOffset=0.00
UsePressureOffset=no
Slot1Sensor1=SV-C.Xchange SV.X SN 201579 04/26/12
Slot3Sensor1=SV-C.Xchange C.X SN 500237 05/04/12
Slot5Sensor1=P-T.Xchange P.X SN 300312 05/04/12 T.X SN 400458 05/04/12

[Data]
05/08/12 12:54:19.03 1486.107 00.076 0000.09 21.236 009.85
05/08/12 12:54:19.10 1486.105 00.076 0000.17 21.236 009.85
05/08/12 12:54:19.16 1486.108 00.077 0000.17 21.236 009.85
05/08/12 12:54:19.23 1486.105 00.076 0000.17 21.236 009.85
05/08/12 12:54:19.29 1486.102 00.077 0000.17 21.236 009.85
05/08/12 12:54:19.36 1486.108 00.076 0000.17 21.236 009.85
05/08/12 12:54:19.43 1486.102 00.077 0000.17 21.236 009.85
05/08/12 12:54:19.50 1486.105 00.075 0000.09 21.236 009.85
05/08/12 12:54:19.57 1486.107 00.076 0000.25 21.236 009.85
05/08/12 12:54:19.64 1486.104 00.076 0000.25 21.236 009.85
05/08/12 12:54:19.71 1486.105 00.076 0000.17 21.236 009.85
05/08/12 12:54:19.78 1486.111 00.077 -0000.13 21.236 009.85
05/08/12 12:54:19.84 1486.101 00.076 -0000.21 21.236 009.85
05/08/12 12:54:19.91 1486.107 00.076 0000.02 21.236 009.85

Support

Troubleshooting

Instrument fails to communicate:

- Is the connector damaged?
- Check the cables
    - Is the data/power cable connected to the instrument and computer?
    - Are there any cuts in the cable?
    - If using a cable other than an AML cable, it should be configured as a null modem cable.
    - If using multiple cable lengths, the extensions should **not** be configured as null modem cables.
- If using external power over a long cable, check the voltage drop over the cable. Measure the voltage across a 10 watt, 27Ω resistor across pins 1 and 4 of the cable. The voltage should be between 9.9 and 26 volts.
- Are the communication settings in the program used on the computer correct?
    - Comm port selection
    - 8 bits
    - 1 stop bit
    - No parity
    - No hardware flow control
    - Baud rate between 600 and 38,400 baud
- Are the communication settings in the instrument correct?
    - Was the instrument specifically set to one baud rate last time? If so, use that baud rate to resume communications.
    - Was the instrument set to only RS-232 or only RS-485 last time? If so, resume communications in the required protocol.
    - Was the instrument set to *RX OFF* last time? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode.
- Was the instrument set to monitor on power up mode? If so, a carriage return must be sent to the instrument immediately after power is applied to interrupt this mode. To interrupt monitor on power up, hold down the ENTER key while applying power to the instrument.

Instrument fails to log:

- Verify the LED indicator status:
    - With the instrument in air (NOT submerged), insert the communication cable. The LED indicator should show solid green indicating the instrument is powered and ready

      Note: If neither a SV•Xchange™ or Conductivity•Xchange™ sensor is installed the instrument will begin logging in air.
    - Place the instrument sensors in water. The LED indicator should remain green and begin flashing, indicating the instrument is powered and logging.
    - If the LED indicator shows red, increase the supply voltage to between 10 and 36 volts.

    - If the indicator does not light up, the instrument is not operating correctly. Continue with the remaining troubleshooting items.
- Allow at least two sample periods for the instrument to detect that it is immersed.
- Were the sound velocity increment, pressure increment and/or sample rate settings set to values that could prevent logging?
- Was the log file name set correctly?
- Is the connector damaged, dirty, or corroded?
- If all previous steps fail, reset the instrument. Send an *INIT* command to the instrument to re-initialize the memory. Note: The *INIT* command will completely erase all settings stored on the instrument.

Instrument generates noisy data:

- Is the connector damaged, dirty, or corroded?
- If connected to external power, is there noise on the power supply? Switch-mode power supplies are common sources of noise.
- Nearby EMI sources such as electric motors, generators, and transformers can create noise. If possible, move the instrument and its cables away from the noise source.
- Are the sensor/s clean?
- Are there bubbles on or in the sensor/s?
- Are the sensor/s damaged?
- Is there something nearby affecting the water temperature?

SeaCast fails to recognize a sensor:

- Be sure to download the latest version of SeaCast
    - Turbidity•Xchange requires SeaCast version 3.0 or greater for full functionality.

SV•Xchange data does not match CTD-calculated SV:

- Owing to the error associated with each individual sensor and Chen and Millero's equation[1], sound velocity calculated from CTD values will fall within approximately ±0.4 m/s of the actual value 95% of the time. It is not uncommon to see differences of this size between directly measured sound velocity and CTD-calculated sound velocity.

[1] Chen-Tung Chen and Frank J. Millero, "Speed of sound in seawater at high pressures," *The Journal of the Acoustical Society of America* 62, no. 5 (1977): 1129-1135.

Contact AML Oceanographic

Service
To request an RMA or technical support

Email: service@AMLoceanographic.com
Phone: 1-250-656-0771
Phone : 1-800-663-8721 (NA)
Fax: 1-250-655-3655

Sales
For all general sales inquiries

Email: sales@AMLoceanographic.com
Phone: 1-250-656-0771
Phone : 1-800-663-8721 (NA)
Fax: 1-250-655-3655

Website
http://www.AMLoceanographic.com

Customer Portal
My AML Oceanographic is AML's online data centre. This secure area within our website is designed to offer one easy location for interested individuals and organizations - distributors, customers, prospects, and other members of our community - to manage their interactions with AML. *My AML Oceanographic* will allow you to:

- View and manage your assets (instruments and sensors)
- Consult instrument diagnostic summaries
- View and download calibration and conformity certificates
- View and manage your technical support cases
- Consult and download sales estimates, sales orders, and invoice copies
- View account balances and generate account statements
- Assess inventory availability at AML

To access the Customer Portal, please navigate to the *Support* button - located on the top right of the AML Oceanographic home page - select *Customer Centre* from the options on the drop down menu and follow the instructions provided.

Mailing and Shipping Address

AML Oceanographic
2071 Malaview Ave.
Sidney, BC, Canada
V8L 5X6

Appendices

Commands

When using SeaCast, the full command set is not usually necessary. However, text commands are available. Below is a listing of commonly used commands. Note that some commands are only available on instruments equipped with the appropriate Xchange™ sensors.

Communications Commands

Command	Description	Requires
SET FORCE 232	Sets com mode to RS-232. Power must be cycled for changes to take effect.	
SET FORCE 485	Sets com mode to RS-485. Power must be cycled for changes to take effect.	
SET FORCE AUTO	Sets for auto-detection of RS-232 or RS-485 comms. Note that if instrument is not connected to a com port on power up, it assumes RS-485 operation and will remain in that mode until powered down.	
DISPLAY FORCE	Displays current com mode (ie RS232, RS485, AUTO)	
DISPLAY DETECT	Displays the baud rate detection settings.	
SET DETECT a b	Sets the baud rate detection. "a" sets the number of autobaud detection attempts before the instrument reverts to the default baud rate set by "b." Setting 'a'=0 forces the instrument to a fixed baud rate determined by "b." '"b"= 1 = 600 baud 4 = 4800 baud 7 = 38400 baud 2 = 1200 baud 5 = 9600 baud 8 = 57600 baud 3 = 2400 baud 6 = 19200 baud 9 = 115200 baud	

Sampling Rate Commands

Command	Description	Requires
DISPLAY SAMPLE RATE	Displays the time-based sampling rate.	
SET SAMPLE n t	Sets the desired sampling rate. "n" is a number and "t" is the time units. Using the slash (/) character should be read as "per". For instance, 5 s means sampling happens every 5 seconds. 5/s means 5 samples per second. Examples are: SET S C sets the sampling to continuous (25 Hz) SET S 5 /s 5 samples per sec SET S 1 s Sample 1 time every 1 second SET S 2 /m 2 samples per minute SET S 5 m Sample 1 time every 5 minutes SET S 2 /h 2 samples per hour SET S 24 h Sample 1 time every 24 hours	
DISPLAY INCREMENT	Displays logging increment for pressure in dBars.	P•X
SET PRESSURE INCREMENT n	Sets logging by increment of pressure specified by n = increment value in dBar (resolution of 2 decimal places).	P•X
SET SOUND INCREMENT n	Sets logging by increment of SV specified by n = increment value in m/s (resolution of 1 decimal place).	SV•X
DISPLAY SOUND INCREMENT	Displays the logging increment for sound velocity in m/s.	SV•X

Output Format Commands

Command	Description	Requires
DISPLAY SCAN	Displays current scan options.	
SET SCAN NOBAT	Turns the battery channel off.	
SET SCAN BAT	Turns the battery channel on.	
SET SCAN NODENSITY	Turns the calculated density channel off.	C•X, T•X, and P•X or SV•X, T•X, and P•X
SET SCAN DENSITY	Turns the calculated density channel on.	C•X, T•X, and P•X or SV•X, T•X, and P•X
SET SCAN NOSALINITY	Turns the calculated salinity channel off.	C•X, T•X, and P•X or SV•X, T•X, and P•X
SET SCAN SALINITY	Turns the calculated salinity channel on.	C•X, T•X, and P•X or SV•X, T•X, and P•X
SET SCAN NOSV	Turns the calculated sound velocity channel off, removing it from the instrument output scans. Current salinity display status is viewable using DIS SCAN.	C•X, T•X, and P•X
SET SCAN SV	Turns the calculated sound velocity channel on, allowing it to be present in instrument output scans. Current salinity display status is viewable using DIS SCAN. This is only available when C,P and T sensors are attached.	C•X, T•X, and P•X
SET SCAN TIME	Enables displaying time in data scan.	
SET SCAN NOTIME	Disables time from being displayed in data scan.	
SET SCAN DATE	Enables displaying date in data scan.	
SET SCAN NODATE	Disables date from being displayed in data scan.	
DISPLAY STARTUP	Displays the power up output settings.	
SET STARTUP PROMPT	Sets the instrument to wait for user commands on power up.	
SET STARTUP SCAN	Sets the instrument to output one scan on power up and then wait for a user command.	
SET STARTUP MONITOR	Sets the instrument to start monitoring data on power up	
SET STARTUP NOHEADER	Disables the instrument identification header output on power up.	
SET STARTUP HEADER	Enables the instrument identification header output on power up.	

Logging Commands

Command	Description	Requires
SET SCAN LOGGING	Enables simultaneous logging and real-time output. If real-time logging in air is desired, set instrument conductivity threshold and sound velocity and pressure increments to zero.	
SET SCAN NOLOGGING	Disables simultaneous real-time logging.	
SET TIMEOUT nn	nn is time in minutes from 0 to 30. Enters logging mode after the specified time interval has passed in which the instrument has been idle. Power the unit off, then on to exit	

	the logging mode. A time interval of 0 will deactivate the command. Setting is viewable using DIS STARTUP.	
LOG	Puts unit into logging mode from real-time mode. It will remain in logging mode until power is turned off.	
SET LOG tttttttt.ttt	Sets new log file name. tttttttt.ttt = log file name. Name can have up to 8 characters in length and 3 characters for file extension.	
INIT	Clears the instrument's logging memory.	
DIRECTORY	Displays list of files in instrument memory and memory status including amount of memory space free and used.	
DUMP tttttttt.ttt	Dumps the data of the specified logged file defined by tttttttt.ttt in REAL or RAW format depending on the current instrument mode.	
DELETE tttttttt.ttt	Erases specified logged file defined by tttttttt.ttt Maximum 8 character name with 3 character extension.	
DISPLAY LOG	Displays current log file name.	

General Commands

Command	Description	Requires
SCAN	Measures and outputs one scan of data.	
MONITOR	Scan at the set sampling rate.	
VERSION	Displays the instrument identification header.	
DISPLAY OPTIONS	Displays the instrument status and user settings.	
ZERO	Corrects the barometric offset to set zero pressure at surface for current barometric pressure.	P•X
ZERO OFF	Disables barometric offset.	P•X
DIS TIME	Displays current time. Time format is hh:mm:ss.ss	
SET TIME hh:mm:ss.ss	Sets instrument time using 24 hour clock in format hh:mm:ss.ss	
DIS DATE	Displays the current date.	
SET DATE mm/dd/yy	Sets date using mm/dd/yy format.	
DETECT	Checks each slot in logger board to identify what is plugged in and displays sensor / board type and serial number or "empty" for each slot.	
DISPLAY BATTERY	Displays battery channel coefficients and shutdown voltage.	
TALK n	Enables communications directly with a sensor board via the logger board, where n = value from 1-3 that identifies the slot number of the board to be communicated with. See DETECT command.	
CTRL+C	Press CTRL key and C key at same time to exit sensor board talk mode & return to logger communications.	

Technical Specifications

Sensors

Primary Xchange™ Sensors					
Type	Range	Accuracy	Precision	Resolution	Response Time
Conductivity•Xchange™	0 to 2 mS/cm	0.01 mS/cm	0.003 mS/cm	0.001 mS/cm	25 ms at 1 m/s flow rate
Conductivity•Xchange™	0 to 70 mS/cm	0.01 mS/cm	0.003 mS/cm	0.001 mS/cm	25 ms at 1 m/s flow rate
Conductivity•Xchange™	0 to 90 mS/cm	0.01 mS/cm	0.003 mS/cm	0.001 mS/cm	25 ms at 1 m/s flow
SV•Xchange™	1375 to 1625 m/s	0.025 m/s	0.006 m/s	0.001 m/s	47 µs

Secondary Xchange™ Sensors					
Type	Range	Accuracy	Precision	Resolution	Response Time
Temperature•Xchange™	-2°C to 32°C	0.005°C	0.003°C	0.001°C	100 ms
Temperature•Xchange™	-5°C to 45°C	0.005°C	0.003°C	0.001°C	100 ms
Temperature•Xchange™	0°C to 65°C	0.005°C	0.003°C	0.001°C	100 ms
Pressure•Xchange™	50, 100, 200, 500, 1000, 2000, 4000, 5000, 6000 dBar	0.05%FS	0.03%FS	0.02%FS	10 ms
Turbidity•Xchange™	0-100 NTU	0.1 NTU	0.1 NTU	0.01 NTU	< 0.7s
Turbidity•Xchange™	0-400 NTU	0.2 NTU	0.2 NTU	0.01 NTU	< 0.7s
Turbidity•Xchange™	0-1000 NTU	0.5 NTU	0.5 NTU	0.1 NTU	< 0.7s
Turbidity•Xchange™	0-3000 NTU	1 NTU	1 NTU	0.1 NTU	< 0.7s

Calculated Parameters				
Type	Required Sensors	Equation	Accuracy	Range
Salinity	C•X, T•X, P•X	TEOS10	±0.010 psu	0 to 42 psu
Salinity (from SV)	SV•X, T•X, P•X	AML '07	±0.035 ppt	0 to 42 ppt
Density	C•X, T•X, P•X	TEOS10	±0.027 kg/m^3	990 to 1230 kg/m^3
Density (from SV)	SV•X, T•X, P•X	TEOS10	±0.051 kg/m^3	990 to 1230 kg/m^3
SV (from CTD)	C•X, T•X, P•X	Chen & Millero '77[2]	0.5 m/s	---

Electrical

- Mother Board
  - Flash, non-volatile data memory (Minimum 1 GB)
  - Three dedicated slots
    - One or Two Primary Xchange™ sensor slots
    - One or Two Secondary Xchange™ sensor slots
  - Four expansion slots
- Sensor Boards
  - Primary Xchange™ sensor board(s)
  - Secondary Xchange™ sensor board(s)
- Auto detect RS232 or RS485 (½ duplex ASCII)
- Autobaud to 38,400

Power

- External Power Supply: 10 to 36 VDC
- Current Draw
  - See tables on following pages
  - 50 mA in standby mode
  - 60 µA when in low power mode

[2] Chen and Millero, "Speed of sound in seawater at high pressures," 1129-1135.

P1S3 and P1S4 Current Draw						
Primary Sensor	**Secondary Sensor**	**Secondary Sensor**	**Secondary Sensor**	**Secondary Sensor**	**Current Draw [mA] - 12VDC +/- 5 mA**	**Current Draw [mA] - 24VDC +/- 5 mA**
C•X	-	-	-	-	120	73
SV•X	-	-	-	-	122	73
-	T•X	-	-	-	136	79
-	P•X	-	-	-	125	74
-	Tu•X	-	-	-	131	76
SV•X	P•X	-	-	-	123	73
SV•X	T•X	-	-	-	132	78
SV•X	Tu•X	-	-	-	130	76
SV•X	T•X	Tu•X	-	-	143	83
SV•X	P•X	T•X	-	-	137	80
SV•X	P•X	T•X	Tu•X	-	146	85
SV•X	T•X	Tu•X	UV•X (SINGLE)	-	322	179
SV•X	T•X	Tu•X	UV•X (QUAD)	-	434	253
C•X	T•X	-	-	-	132	78
C•X	P•X	-	-	-	123	73
C•X	T•X	P•X	-	-	137	80
C•X	Tu•X	P•X	-	-	133	78
C•X	T•X	Tu•X	-	-	142	83
C•X	P•X	T•X	Tu•X	-	146	85
C•X	P•X	T•X	Tu•X	UV•X (SINGLE)	325	181
C•X	P•X	T•X	Tu•X	UV•X (QUAD)	437	255

P2S2 Current Draw					
Primary Sensor	**Primary Sensor**	**Secondary Sensor**	**Secondary Sensor**	**Current Draw [mA] - 12VDC +/- 5 mA**	**Current Draw [mA] - 24VDC +/- 5 mA**
SV•X	-	-	-	155	90
-	C•X	-	-	155	90
-	-	T•X	-	165	96
-	-	P•X	-	157	92
-	-	Tu•X	-	161	94
SV•X	-	P•X	-	156	91
SV•X	-	T•X	-	166	96
SV•X	-	Tu•X	-	161	94
SV•X	-	T•X	Tu•X	176	100
SV•X	-	T•X	P•X	170	97
-	C•X	T•X	-	168	96
-	C•X	P•X	-	156	90
-	C•X	P•X	T•X	168	97
-	C•X	P•X	Tu•X	167	95
-	C•X	T•X	Tu•X	176	100
SV•X	C•X	T•X	P•X	171	98
SV•X	C•X	T•X	Tu•X	176	100
SV•X	C•X	P•X	Tu•X	167	95
SV•X	C•X	P•X	$UV•X_{(QUAD)}$	493	259
SV•X	C•X	P•X	$UV•X_{(SINGLE)}$	354	191

Pressure Case

- Hard anodized 7075-T6 aluminum (PDC-MTX-PXSX-60)
- Acetal copolymer plastic (PDC-MTX-PXSX-05)
- Environmental Limits
    - Storage: -40°C to 60°C
    - Usage: -20°C to 45°C

Housing					
Type	Depth Rating	Diameter	Length	Weight (in water)	Weight (in air)
7075-T6	6000 m	100mm (4.0")	490mm (19.3")	3.1 Kg (6.7 lbs)	5.2 Kg (11.3 lbs)
Acetyl Copolymer	500 m	100mm (4.0")	490mm (19.3")	1.2 Kg (2.6 lbs)	3.3 Kg (7.2 lbs)

Bulkhead Connector					
Type	Status	Pins	Sex	Material	Manufacturer
Bulkhead	Delrin housing	Micro 8	Female	Titanium	Subconn

Sampling Capabilities

- Frequency
    - Time: From 25 samples per second to 1 per 24 hours
    - Pressure: Specific pressure increments in 0.01 dbar steps
    - Sound Velocity: Specific sound velocity increments in 0.1 m/s steps
- Configurations
    - Single scan or continuous output
    - On command or autonomous on power up

Included Items

- Metrec•X Instrument
- 2m Data/Power Pigtail
- Black dummy plug
- Two primary sensor blanking plug
- Two secondary sensor blanking plugs
- USB stick with manuals and documentation

Software

- SeaCast

Ordering Codes

Instruments

PDC-MTX-P1S4-60	METREC•X, P1S4, 6000m Housing
PDC-MTX-P2S2-60	METREC•X, P2S2, 6000m Housing
PDC-MTX-P1S4-05	METREC•X, P1S4, 500m Acetal Housing
PDC-MTX-P1S3-UV-05	METREC•X, P1S3 plus a dedicated UV port, 500m Acetal Housing

Sensors

XCH-SV-STD	SV•Xchange™ (1375-1625m/s) Range *Replaces XCH-0002*
XCH-SV-1120	SV•Xchange™ (1100-2000m/s) Range
XCH-SV-0520	SV•Xchange™ (500-2000m/s) Range
XCH-CND-RA002	C•Xchange™ Right Angle, Ultra Freshwater (0-2mS/cm) Range
XCH-CND-RA070	C•Xchange™ Right Angle, Oceanographic (0-70mS/cm) Range
XCH-CND-RA090	C•Xchange™ Right Angle, Oceanographic (0-90mS/cm) Range
XCH-CND-ST002	C•Xchange™ Straight, Ultra Freshwater (0-2mS/cm) Range
XCH-CND-ST070	C•Xchange™ Straight, Oceanographic (0-70mS/cm) Range
XCH-TMP-n232	T•Xchange™ (-2 to 32 C) Range
XCH-TMP-n545	T•Xchange™ (-5 to 45 C) Range
XCH-TMP-065	T•Xchange™ (0 to 65 C) Range
XCH-PRS-0050	P•Xchange™ 50 dBar
XCH-PRS-0100	P•Xchange™ 100 dBar
XCH-PRS-0200	P•Xchange™ 200 dBar
XCH-PRS-0500	P•Xchange™ 500 dBar
XCH-PRS-1000	P•Xchange™ 1000 dBar
XCH-PRS-2000	P•Xchange™ 2000 dBar
XCH-PRS-4000	P•Xchange™ 4000 dBar
XCH-PRS-5000	P•Xchange™ 5000 dBar
XCH-PRS-6000	P•Xchange™ 6000 dBar
XCH-PRS-6000-T065	P•Xchange™ 6000 dBar, Extended temperature calibration from 0-65 C
XCH-TRB-0100-03	Tu•Xchange™ (0-100 NTU) Range, 300m
XCH-TRB-0100-05	Tu•Xchange™ (0-100 NTU) Range, 500m
XCH-TRB-0400-03	Tu•Xchange™ (0-400 NTU) Range, 300m
XCH-TRB-0400-05	Tu•Xchange™ (0-400 NTU) Range, 500m
XCH-TRB-1000-03	Tu•Xchange™ (0-1000 NTU) Range, 300m
XCH-TRB-1000-05	Tu•Xchange™ (0-1000 NTU) Range, 500m
XCH-TRB-3000-03	Tu•Xchange™ (0-3000 NTU) Range, 300m
XCH-TRB-3000-05	Tu•Xchange™ (0-3000 NTU) Range, 500m
XCH-UV-LLLV	UV•Xchange, 3 lower power sideways facing modules + vertical module
XCH-UV-V	UV•Xchange, single vertical module

Upgrade Options & Accessories

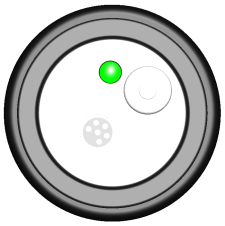
CSE-0026	Copper (Cu/Ni) Cage. Includes retaining collar.
MBR-PLX-STD	Mounting Clamps for Plus•X and Metrec•X instruments. 1 Pair (2 clamps)

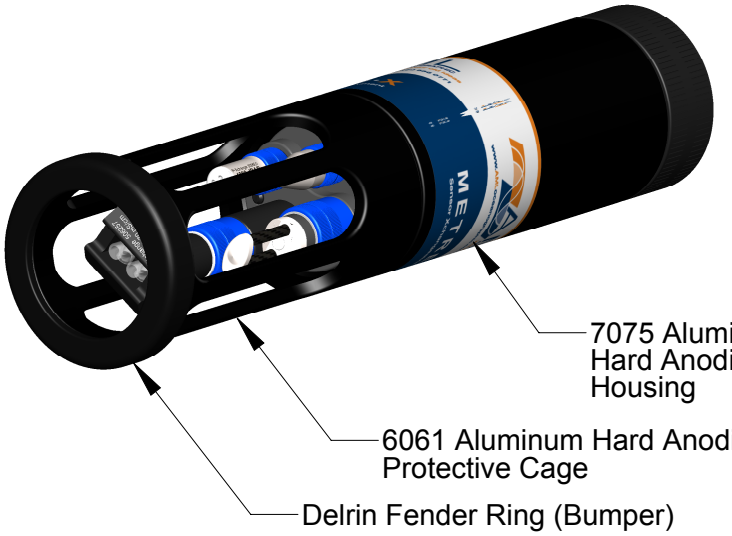
Warranty

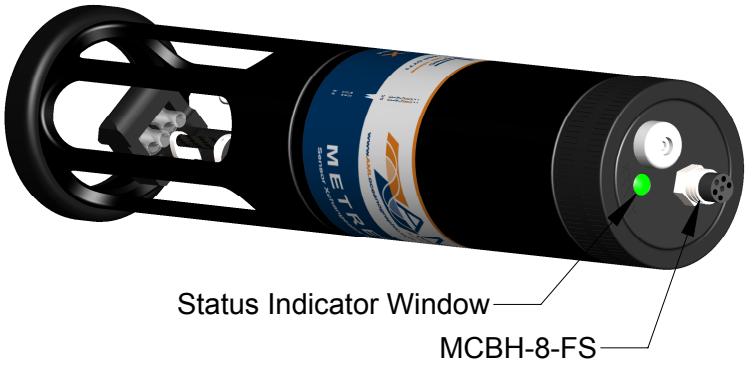
AML Oceanographic warrants the instrument for a period of two years from the date of delivery. AML will repair or replace, at its option and at no charge, components which are found to be defective. The warranty applies only to the original purchaser of the instruments. The warranty does not apply if the instrument has been damaged, by accident or misuse, and is void if repairs or modifications are made by any other than authorized personnel.

This warranty is the only warranty given by AML. No warranties implied by law, including but not limited to the implied warranties of merchantability and fitness for a particular purpose shall apply. In no event will AML be liable for any direct, indirect, consequential, or incidental damages resulting from any defects or failure of performance of any instrument supplied by AML.

Technical Overview Drawings







NOTES:

1. **Dimensions in inches [millimeters]**
2. **Depth Rating: 6000m**
3. **Weight (w/o sensors): 5.0 kg (Air) 3.0 kg (Water)**
4. **X-Series is available in two endcap configurations: PDC-MTX-P2S2-60 and PDC-MTX-P1S4-60**

where: PDC-MTX-P_S_-60

No. of Primary Mounts:
SV Xchange
C Xchange

No. of Secondary Mounts:
DO Xchange
P Xchange
T Xchange
TU Xchange

REVISION TABLE			
REV	DESCRIPTION	BY	DATE
A	INCREASED LENGTH	C.B.	12 FEB/14

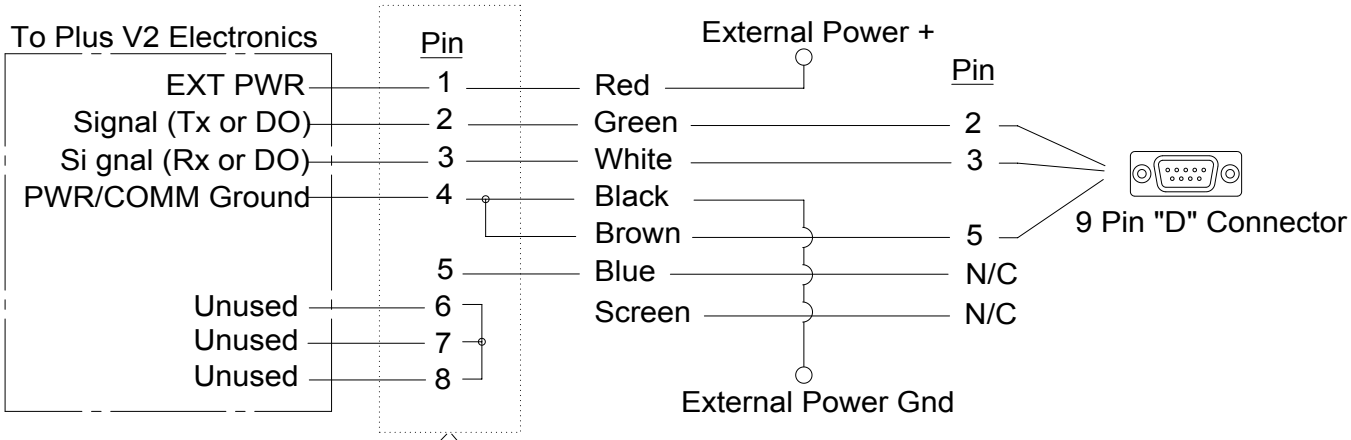
AML OCEANOGRAPHIC
Xchange your old ideas
2071 MALAVIEW AVE. W., SIDNEY, B.C. CANADA V8L 5X6
PH:(250) 656 0771 FAX: (250) 655 3655
www.AMLoceanographic.com

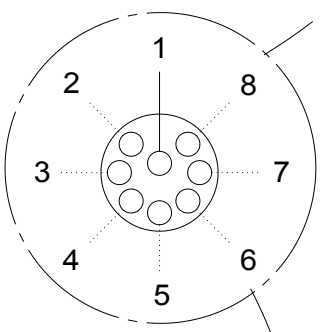
TITLE

METREC•X SERIES MECHANICAL OUTLINE

SYSTEM	*AML PART NO.*
METREC•X	PDC-MTX-P1S4/P2S2-60
DATE	*SLDRW NO.*
27 JUN 2012	MC7-GA-03531-A

Micro 8 Provides RS232 or RS485 Serial Communications





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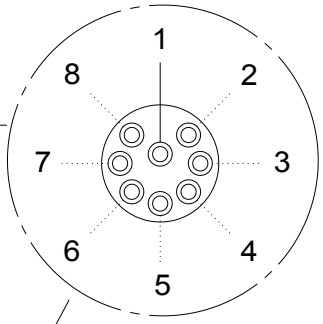
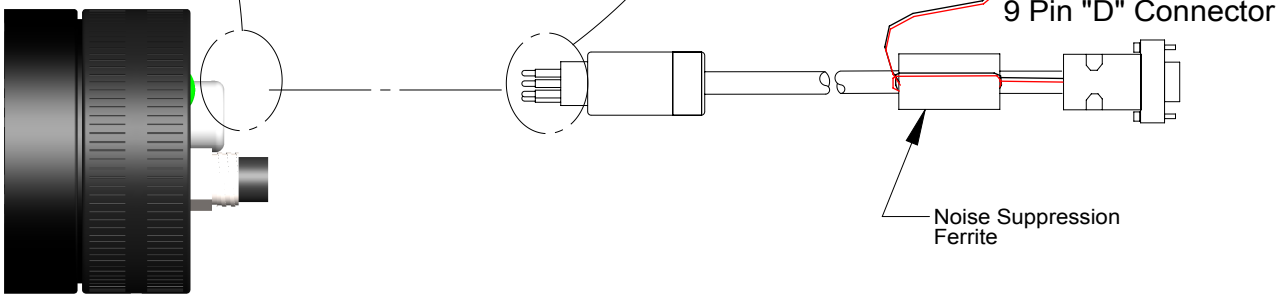


PMCIL-8-MP



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2071 MALAVIEW AVE. W., SIDNEY, B.C. CANADA V8L 5X6
PH:(250) 656 0771 FAX: (250) 655 3655
www.AMLoceanographic.com

TITLE

METREC•X SERIES
COMMS AND POWER INTERFACE

SYSTEM	*AML PART NO.*
METREC•X	PDC-MTX-P1S4/P2S2-60
DATE	*SLDRW NO.*
27 JUN 2012	MC7-GA-03531-A

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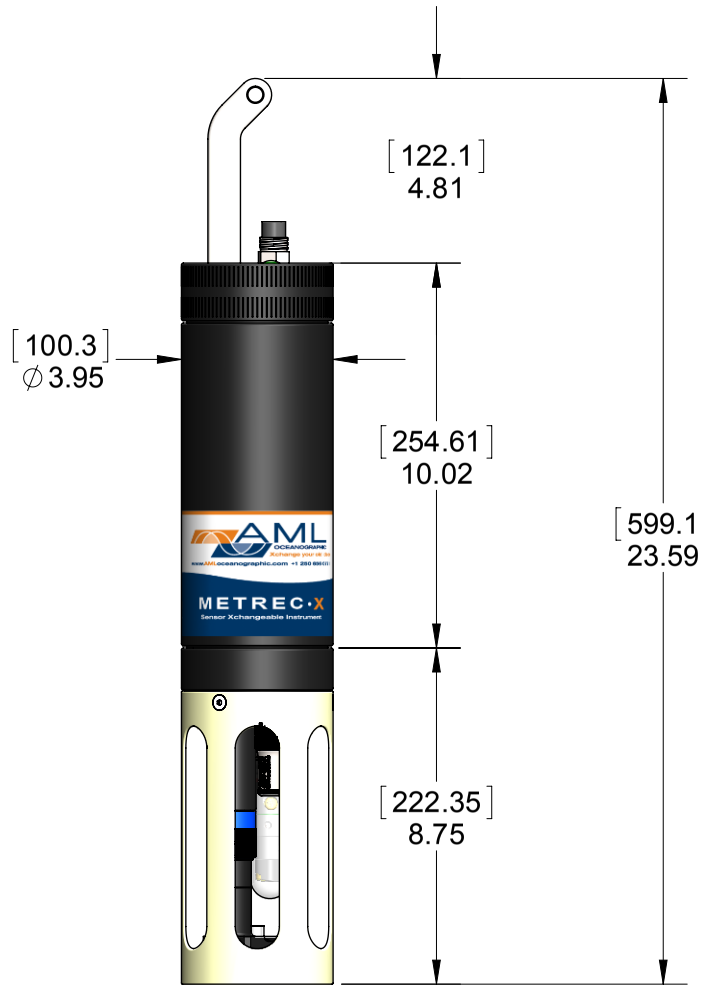

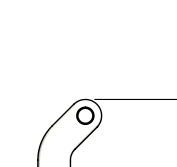

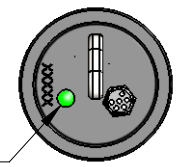

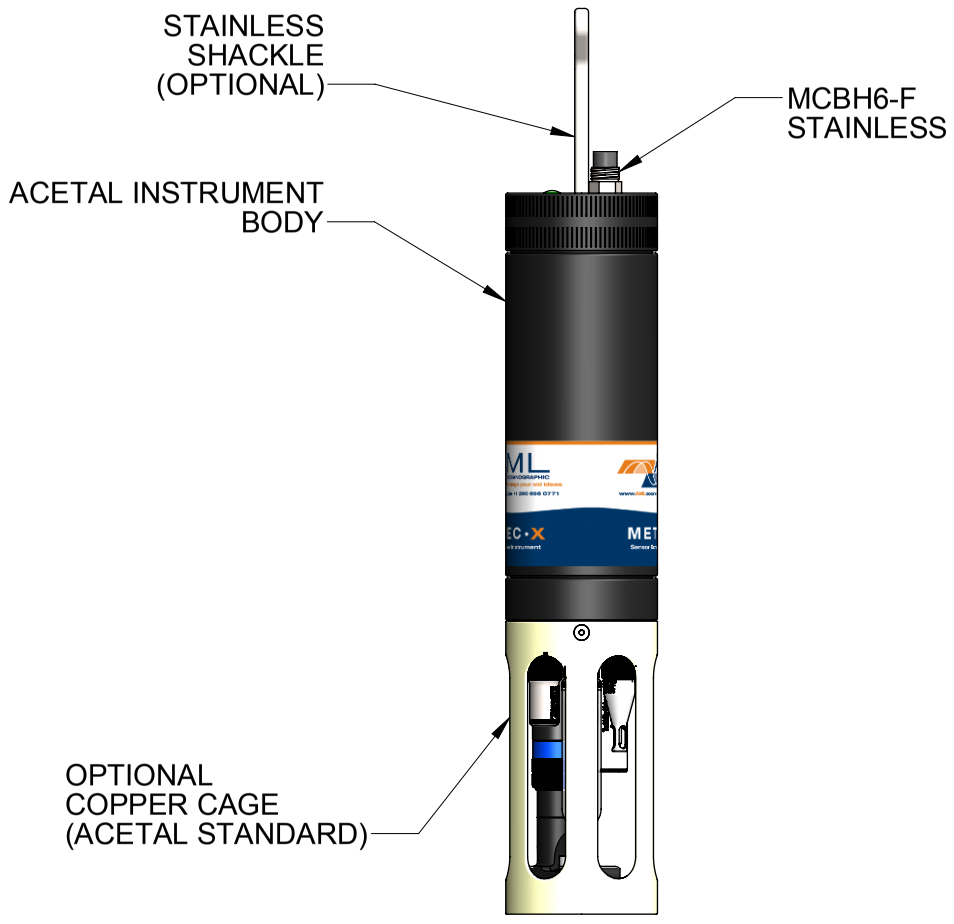

REV	DESCRIPTION	BY	DATE
B	CAGE UPDATED	ABT	25AUG2015
A	PIN OUT CORRECTED	DO	13SEP2014

AML OCEANOGRAPHIC
Xchange your old ideas
2071 Malaview Ave., Sidney B.C. Canada, V8L 5X6 Ph: (250) 656 0771 Fax: (250) 655 3655

THIS DRAWING CONFORMS TO ASME Y14.5-2009

DIMENSIONS AND TOLERANCES:
UNITS: INCHES [MM]
ANGLES: ± 1°
FRACTIONS: ± 1/32
HOLE SIZES: ± 0.005(0.13)
0.00: ± 0.015(0.38)
0.000: ± 0.005(0.13)

UNLESS OTHERWISE SPECIFIED:
ORIGINAL SCALE:1:5
HOLE DEPTHS GIVEN FOR FULL DIAMETER.
SURFACE FINISH: 63

TITLE:
METREC•X WITH INDEPENDENT UV CUSTOMER OVERVIEW

DRAWN CB	*DATE* 23JUL2015	*DRAWING NO.:* BFC-MA-03874-B	*REV*	*AML NO.* PDC-MTX-P1SUV3-05
REVIEWED DO	*DATE* 13SEP2014	*MATERIAL:* Acetal Copolymer		
	SIZE B	*SLD FILE NO.:* MC7-MA-03897-B		*SHEET NO.* Sheet 1 of 2

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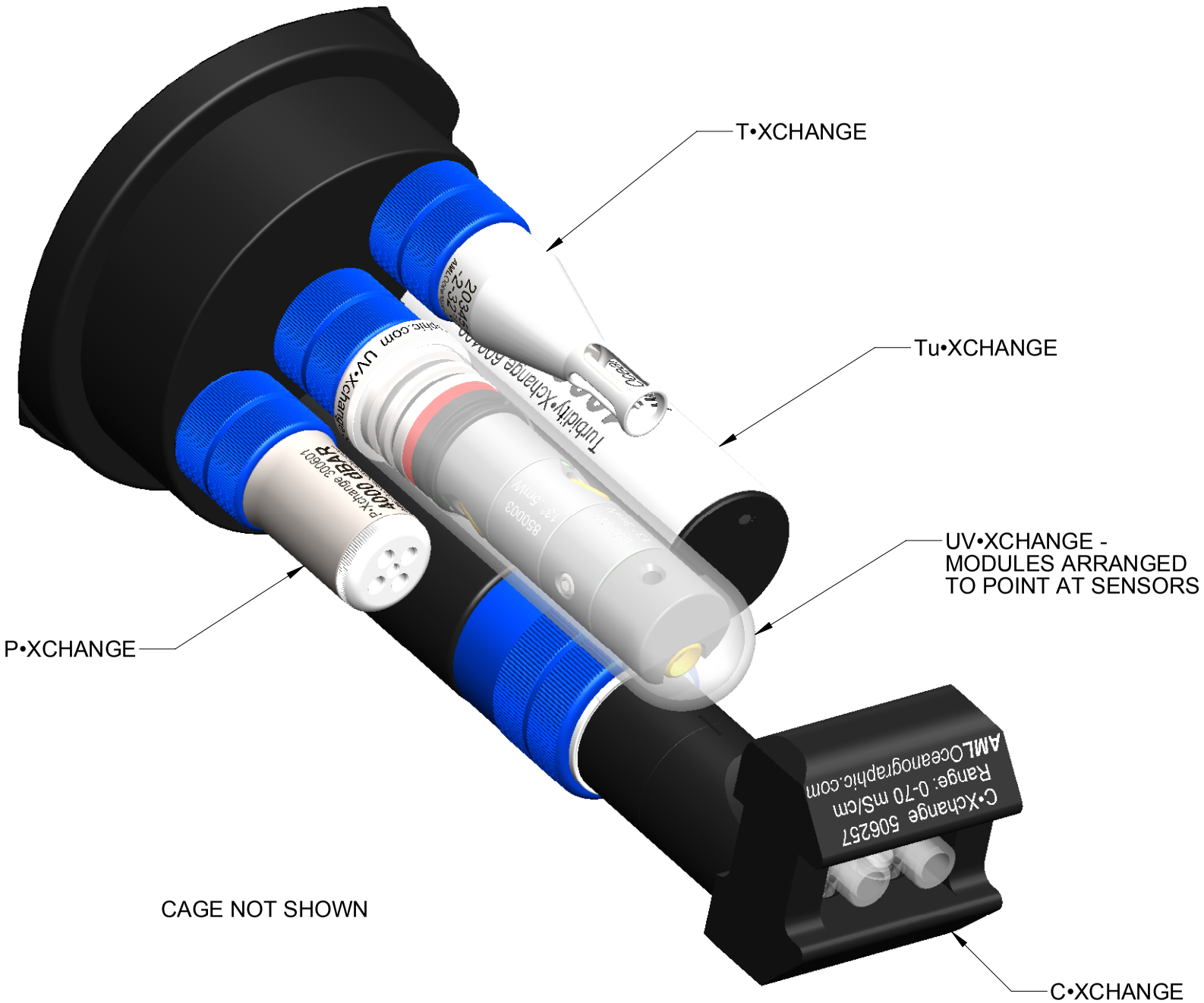

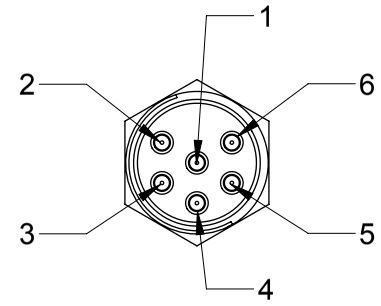

MCBH-6-F
FEMALE FACE VIEW

PIN	FUNCTION
1	SIGNAL (Rx)
2	PWR/COMM GND
3	EXT PWR (8-26 VDC)
4	SIGNAL (Tx)
5	UV•XCHANGE PWR (12-26 VDC)
6	UV•XCHANGE GND

REV	DESCRIPTION	BY	DATE
B	CAGE UPDATED	ABT	25AUG2015
A	PIN OUT CORRECTED	DO	13SEP2014

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UNLESS OTHERWISE SPECIFIED:
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HOLE DEPTHS GIVEN FOR FULL DIAMETER.
SURFACE FINISH: 63

TITLE:
METREC•X WITH INDEPENDENT UV CUSTOMER OVERVIEW

DRAWN CB	*DATE* 23JUL2015	*DRAWING NO.:* BFC-MA-03874-B *REV*	*AML NO.* PDC-MTX-P1S3UV-05
REVIEWED DO	*DATE* 13SEP2014	*MATERIAL:* Acetal Copolymer	
SIZE B		*SLD FILE NO.:* MC7-MA-03897-B	*SHEET NO.* Sheet 2 of 2

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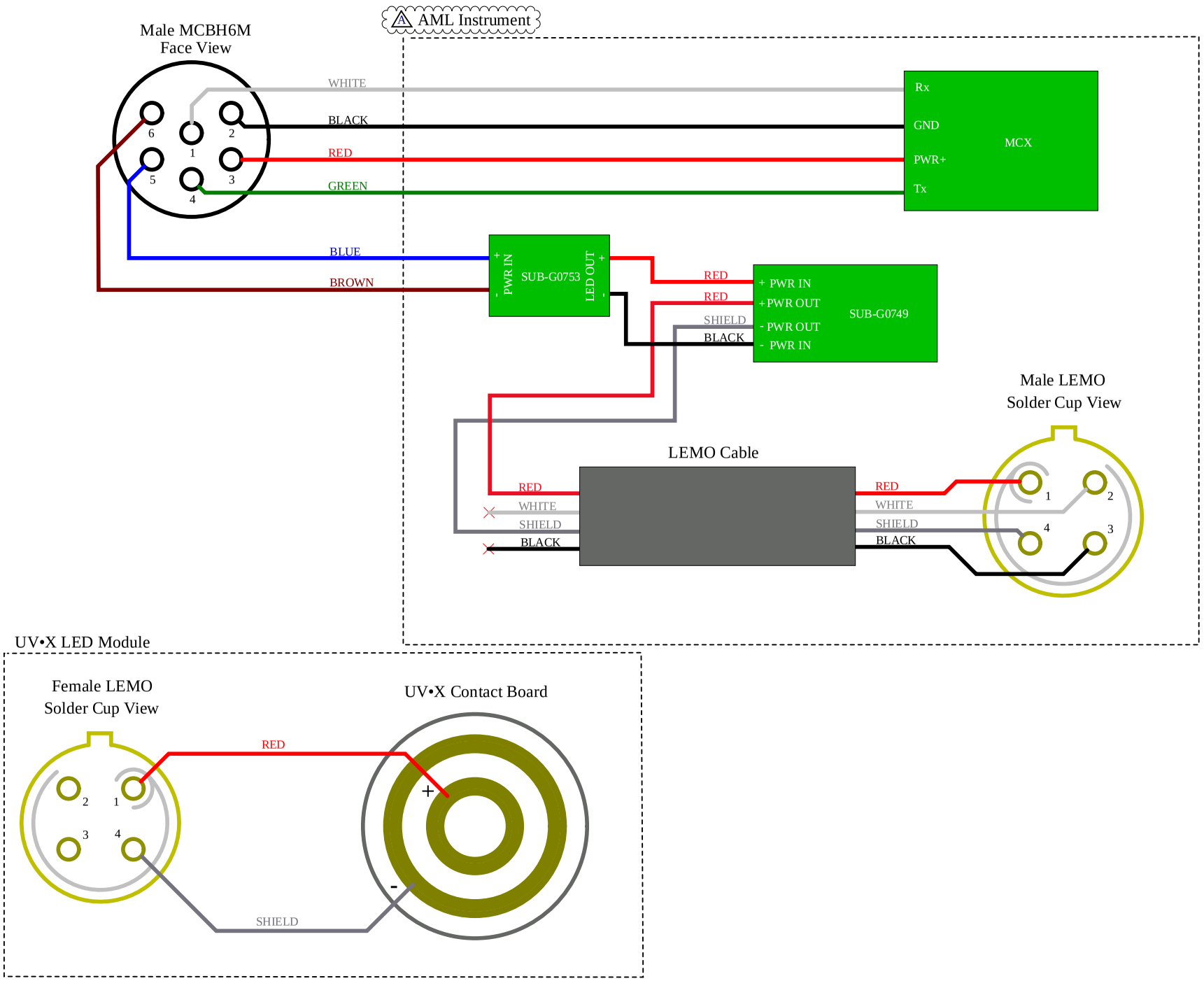

REV	Description	By	Date
A	Changed Text	KDC	July 16/15

Title	Instrument With Internal DCC Wiring Diagram		
Size: Tabloid	Number: MC7-EA-04020-A	Revision: A	
Date: 8/25/2015	Time: 8:05:27 AM	Sheet 1 of 1	

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